



Basic Ultrasound Physics Board Review Questions

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Question 1



What is the wavelength of 2 MHz sound in soft tissue?

1. 1.54 mm
2. 0.75 mm
3. 0.75 cm
4. 0.75 m
5. 0.77 s





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The wavelength of sound in soft tissue equals 1.54 mm divided by the frequency (with units of MHz). 1.54 mm divided by 2 equals 0.77 mm. Thus, 2 is the best answer.



Question 2



In soft tissue, what is the most common mechanism resulting in attenuation?

1. reflection
2. refraction
3. transmission
4. **attenuation**
5. absorption





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1. reflection
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4. attenuation
5. absorption

Of these choices, the primary component of attenuation is absorption.



Question 3



Which of the following waves will travel fastest in bone?

1. high frequency, high intensity
2. low frequency, long period
3. short period, short wavelength
4. low intensity, low frequency
5. none of the above





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The speed of sound in any medium depends only upon the characteristics of the medium. Speed is independent of the sound wave's characteristics.



Question 4



The major source of ultrasound information used to create a two-dimensional image is:

1. Specular reflections
2. Raleigh scattering
3. Scattering
4. Backscatter





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Backscatter (diffuse) and specular reflections redirect sound energy back towards the transducer. Since backscatter redirects energy in many directions, the sound wave is more likely to be received by the transducer and used to create an image.



Question 5



Which of the following best estimates the speed of sound in soft tissue?

1. 1540 km/s
2. 1.54 km/ms
3. 1500 m/s
4. 1540 mm/s
5. 1.54 cm/s



Question 5



Which of the following best estimates the speed of sound in soft tissue?

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2. 1.54 km/ms
3. 1500 m/s
4. 1540 mm/s
5. 1.54 cm/s

Be careful with units. Sound travels approximately one mile per second in soft tissue. This is best approximated by 1,500 m/s, choice C.



FUNDAMENTALS OF DOPPLER PHYSICS

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Question 1

Which of the following will decrease aliasing?

1. Decreasing the nyquist limit 0.75 mm
2. Image with a higher frequency transducer
3. Use pulsed rather than CW Doppler
4. Image in a view with a shallower depth
5. Decrease the gain



Question 1



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3. Use pulsed rather than CW Doppler
4. **Image in a view with a shallower depth**
5. Decrease the gain

Image in a view with a shallower depth. This increases the PRF and the Nyquist limit. Aliasing is less likely with a higher Nyquist limit.





Question 2

A patient with severe MR is evaluated with TEE. Compared to the initial image, which color Doppler setting will decrease the jet area on TEE from the initial image?

1. Lower the pulse repetition frequency
2. Increase the scale
3. Increasing the Doppler gain
4. Increase compression
5. Decrease the wall filter



Question 2



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2. **Increase the scale**
3. Increasing the Doppler gain
4. Increase compression
5. Decrease the wall filter

Increasing the scale increases the Nyquist limit. Increasing the Nyquist limit will make the system less sensitive to low velocities. Since the edges of a jet are low velocities, the jet will appear smaller.





Question 3

Which of the following is most likely to create alias when using pulsed Doppler?

1. shallow sample volume, low frequency
2. deep sample volume, low intensity
3. deep sample volume, high frequency
4. shallow sample volume, high frequency
5. deep sample volume, low frequency



Question 3

Which of the following is most likely to create alias when using pulsed Doppler?

1. shallow sample volume, low frequency
2. deep sample volume, low intensity
3. **deep sample volume, high frequency**
4. shallow sample volume, high frequency
5. deep sample volume, low frequency

Deeper sample volumes are more likely to alias since the Nyquist limit is lower. High frequency sound is more likely to alias since the Doppler shifts at any given blood cell velocity is higher.





Question 4

Which of the following statements regarding Doppler and two dimensional imaging is true?

1. Imaging is best with higher frequency sound whereas Doppler is best with lower frequencies
2. Both imaging and Doppler are optimal at 90 degree incidence
3. Both imaging and Doppler used pulse wave sound exclusively
4. Doppler is best with normal incidence whereas imaging is best at 60 degree incidence.
5. Imaging transducers may have only one PZT crystal whereas pulse Doppler transducers must have at least two



Question 4

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Imaging with higher frequencies improves axial resolution. Lower frequency sound reduces aliasing. Thus, choice A is correct.





Question 5

Which of the following has the lowest temporal resolution?

1. M-mode
2. Pulsed Doppler with a deep sample volume
3. Color flow, imaging deep
4. Color flow, large packet
5. Color flow, low line density



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Large packets with color flow increases the number of pulses required to make each image. Thus, the frame rate is low and temporal resolution is poor.

